optical transmitters require more time in manufacturing because of the need to co-align the two optical transmitters. Such separate transmitter paths are also more susceptible to misalignments due to mechanical shock and/or thermal stresses.

In cases where the tracking function is performed with the communication beam, a majority of the received optical signal is typically directed to the high-speed detector for the communications channel, while a small portion (*e.g.*, 10 percent) is split off or directed to the tracking detector. For an aligned optical system using a quad cell based tracking sensor, an equal signal in all four quadrants will normally indicate that the steering mechanism has optimally directed the optical communication signal onto the high speed detector, and where there is deviation from this alignment, the steering mechanism will direct the optical signal back to this optimum equilibrium.

One method of signal detection via a tracking detector utilizes a low frequency tone superimposed on a data communication signal which can be recovered using a variety of methods in the receive electronics. An example of such a method is described in detail in commonly-assigned U.S. Patent Application serial No. 09/627,819, issued as U.S. Patent No. 6483621 entitled METHOD AND APPARATUS FOR TONE TRACKING IN WIRELESS OPTICAL COMMUNICATION SYSTEMS, filed July 28, 2000. 7/20/05 NC This method uses a tone (*e.g.*, 20 kHz) superimposed on a data communication signal and having a small modulation depth or occupying a distinct spectral band as compared with the primary digital or modulated data communication signal. The modulation depth of the 20 kHz tone may be as little as a few percent of the amplitude of an on-off keyed ("OOK") signal used to convey digital information, so as not to adversely impact the data communication channel sensitivity. The advantage of tone modulation detection is an enhanced sensitivity gained via use of a narrow-band electronic filter or lock-in detector that will eliminate

require a heterodyne or homodyne type of optical receiver for detection. The receiver discussed in the following assumes that the optical signal 12 is modulated in intensity only, consistent with the above discussion. However, the generality of the receiver to include other methods of optical modulation is within the scope of the present invention.

The operation of receiving components in accordance with embodiments of the present invention may be understood upon reference primarily to Figure 3, which illustrates an embodiment of a free-space optical receiver 41 utilizing a pair of detectors for detecting the optical signal 12 transmitted from a corresponding free-space optical transmitter, as described previously with reference to Figure 1. Components of the receiver 41 may be embodied in a free-space optical terminal to varying degrees in embodiments of the invention, or may be coupled thereto in other embodiments. The optical signal 12 is received by an optical element 42, which may comprise a typical arrangement of lenses and mirrors designed to collect and focus light to a single receiving point as will be apparent to one skilled in the art. In one embodiment, the optical element 42 includes a holographic optical element as described in commonly-assigned U.S. Patent Application Serial No. 09/627,815, issued as U.S. Patent No. 6608708 entitled SYSTEM AND METHOD FOR USING A HOLOGRAPHIC OPTICAL ELEMENT IN A WIRELESS TELECOMMUNICATION SYSTEM RECEIVER, filed July 28, 2000, and incorporated herein by reference.

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The optical signal 12 is collected and transformed by the optical element 42 to produce either a collimated or converging optical signal 44, which is directed to a beam splitter 46 that splits the collimated or converging optical signal 44 into a first optical signal 48, which may comprise a high-speed data component in an embodiment, and a second optical signal 50, which may comprise a tracking signal component in an embodiment. Figure 3 illustrates the